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(56) Documents Cited

GB 2277892 A EP 0677334 A1 EP 0643334 A1  
EP 0454314 A2 US 4267212 A

(58) Field of Search

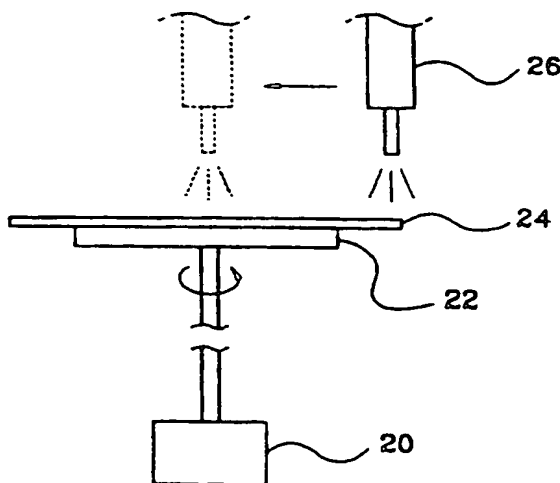
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INT CL<sup>6</sup> B05B 13/04 , G03F 7/16  
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(54) Abstract Title

Photoresist coating apparatus and method

(57) Apparatus and method particularly for coating a semiconductor wafer 24 with a photoresist wherein the wafer 24 is mounted on rotatable chuck 22 driven by variable speed motor 20 and photoresist is sprayed onto the surface of the wafer from a nozzle 26 which traverses the wafer from its edge to its centre, the rotational speed of the wafer being increased as the nozzle moves towards the centre of the wafer.

FIG. 2



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FIG. 1  
(PRIOR ART)

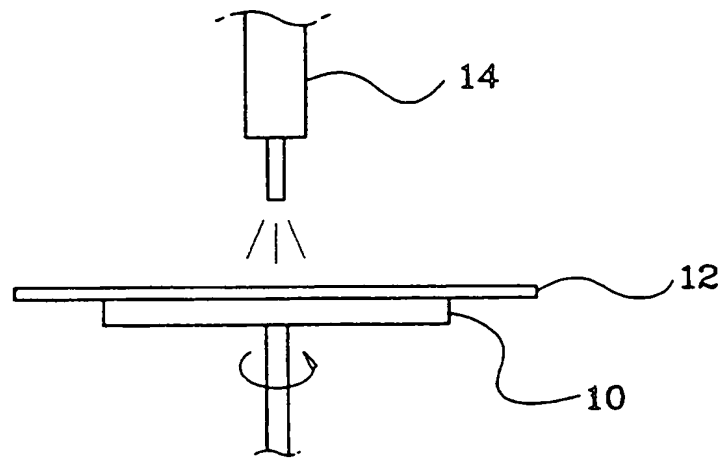


FIG. 2

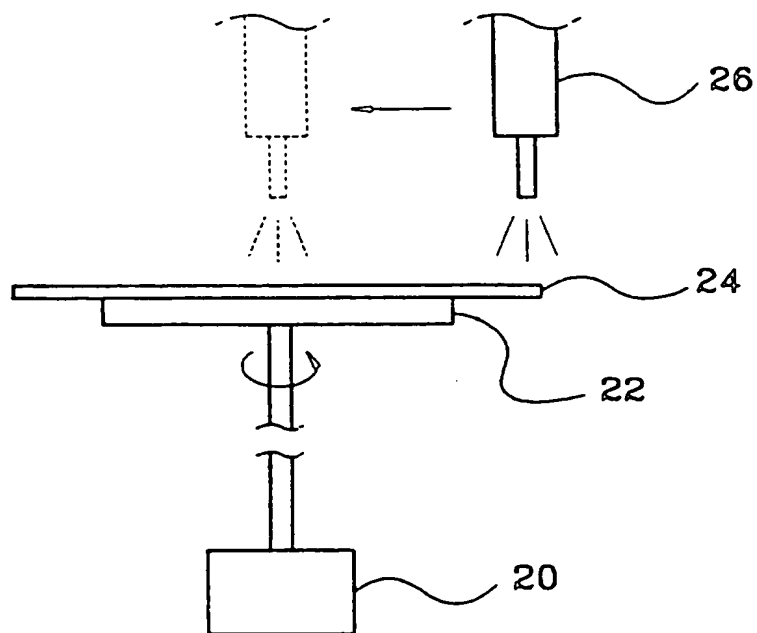


FIG. 3

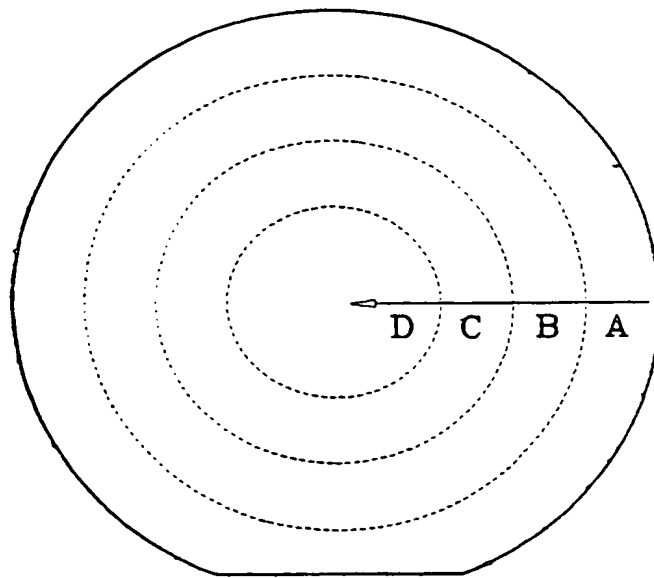
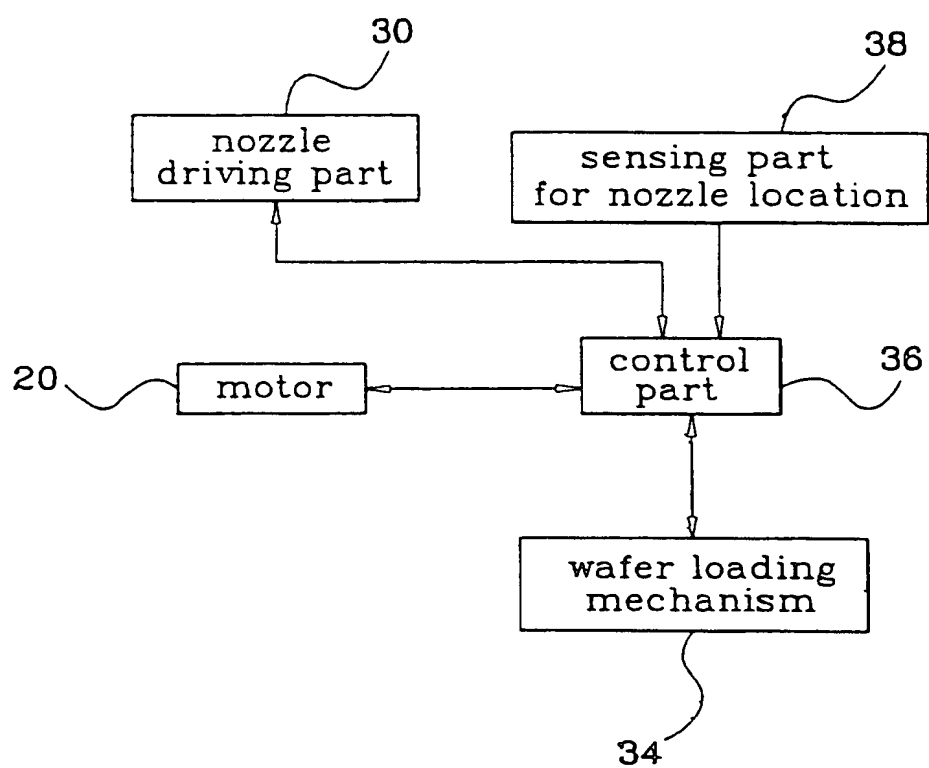


FIG. 4



## PHOTORESIST COATING APPARATUS AND METHOD

Field of the Invention

The present invention relates to a photoresist coating apparatus and a method thereby, and more particularly, a photoresist coating apparatus for minimizing the amount of the photoresist used in the wafer coating by carrying out the process in the scanning way and varying the rotation speed of wafer with respect to each position which the photoresist is sprayed on.

Description of the Related Art

In the semiconductor device fabrication process in which wafers are processed and embodied as semiconductor devices having electrical characteristics, the process using photoresist is used indispensably and the photoresist is used as layer for masking in etching process, or ion implantation process, etc.

The photoresist coating is carried out by spin coater, and the spin coater comprises a pumping part for receiving photoresist from supply source and a coating part for spray-coating the photoresist pump-supplied.

The photoresist pumping in the pumping part is

carried out by nitrogen-pressurized method, and as shown in Fig. 1, in the coating part, photoresist is sprayed through nozzle 14 fixed on a specific location over the wafer 12 which is mounted on the rotation chuck 10 and rotates at normal rate, and the thickness of the sprayed photoresist is controlled by rotation rate.

As shown in Fig. 1, the photoresist sprayed toward the upper center of the wafer 12 spreads toward the peripheral side of the rotating wafer, which is so coated with the photoresist.

However, in order to spray the photoresist on the wafer to coat with, 7 cc ~ 9 cc of photoresist is used for piece, and this amount exceeds the amount which is substantially needed for coating the wafer ( less than 1 cc ).

That is, for the amount of photoresist used to be coated with, photoresist is sprayed on the wafer so much that it causes the waste of lots amount of photoresist and economical loss thereby resulting in the environmental problems in the after-treatment of the photoresist.

Therefore, there is a great demand for developing a method for spraying photoresist for avoiding the waste of the photoresist so that the economical and environmental problems are solved.

## Summary of the Invention

The present invention is directed to provide a photoresist coating apparatus and a method thereby, wherein photoresist is sprayed on wafer for the formation of masking layer in spin coating way while nozzles for spraying the photoresist scan the wafer and the rotation speed of the rotation chuck varies thereby to reduce the waste of the photoresist used.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, the photoresist coating apparatus comprises : a nozzle driving means moving the nozzles from the edge side of the wafer to its center for performing scan coating; a motor for differently supplying rotation force on the rotation chuck with respect to the location of the nozzle ; and a control means for gradually building up the rotation speed of the motor by confirming the location of the nozzle which is moved from the edge side of the wafer to its center by the nozzle driving means.

The control means is constructed such that the rotation speed of the motor is gradually increased linearly or non-linearly while the nozzle scans the wafer from its edge side to its center.

The photoresist coating method for wafer is carried out in such a manner that photoresist is sprayed while

nozzle scans the wafer from its edge side to its center,  
the rotation speed of the wafer being increased during  
the scan.

5 It is to be understood that both the foregoing  
general description and the following detailed  
description are exemplary and explanatory and are  
intended to provide further explanation of the invention  
as claimed.

#### Brief Description of the Drawings

10 In the accompanying drawings :

Fig. 1 is a schematic view showing the conventional  
photoresist coating apparatus ;

15 Fig. 2 is a schematic view showing one embodiment of  
the photoresist coating apparatus according to the  
present invention ;

Fig. 3 shows the coating surface of the wafer its  
rotation speed being different with respect to section  
during photoresist spray ; and

20 Fig. 4 is a block diagram showing one embodiment  
according to the present invention.



## Detailed Description of the Preferred Embodiments

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

5        According to one embodiment of the photoresist coating apparatus of the present invention, as shown in Fig. 2, the photoresist coating apparatus is constructed in such a manner that a wafer 24 is chucked on the rotation chuck 22 receiving the rotation force from a  
10       motor 20, and nozzle 26 is provided over it for scanning the wafer 24 from its edge side to its center.

      The rotation speed of the rotation chuck 22 varies with each point of nozzle 26, that is, spraying position thereof, and driving force is transferred to the rotation  
15       chuck 22 by motor 20, which determines the rotation speed as in advance set-up value considering the distance between the center of the spraying position and the motor 20. That is, driving force is transferred from the motor  
20       20 to the rotation chuck 22 such that the rotation speed is increased when the nozzle 26 is placed on the center of the wafer rather than its edge, and the wafer 24 is rotated by the rotation of the rotation chuck 22.

      In this stage, the rotation speed is designed to be increased linearly or non-linearly when nozzle 26 is  
25       moving for scanning the wafer 24 from its edge to its center according to the intention of a manufacturer, and

according to one embodiment of the present invention as shown in Fig. 3, the wafer is divided as A,B,C,D, sections on its plane surface so that the rotation speed of the wafer is controlled to linearly be increased step by step with respect to each section.

In the embodiment of the present invention, photoresist is sprayed for coating while nozzle 26 scans the wafer and the rotation of the wafer varies according to the block diagram as shown in Fig. 4. That is, the control of the motor 20 driving and the nozzle 26 scans is arranged responsive thereto.

In detail, a nozzle driving part 30, a motor 20, and a wafer loading mechanism 34 are interfaced with a control part for operation, and a nozzle location sensing part 38 for detecting the location of the nozzle 26 applies sensing signal to the control part 36.

Now hereinafter, the operation of the embodiment of the present invention is in detail described.

Wafers are transferred by a wafer loading mechanism 34 by piece, and mounted on the rotation chuck 22 so as to be chucked in, the control part 36 rotates the wafer 24 chucked in on the rotation chuck 22 in an early normal speed, and if it is reached in a normal speed, scanning coating starts its operation controlling the nozzle driving part 30.

When the scanning coating starts its operation, the nozzle 26 is moved from the edge side ( Sec. A of Fig. 3

) of the wafer to the center side ( Sec. D of Fig. 3 ),  
and the location of the nozzle moving is detected by the  
nozzle location sensing part 38.

5 The nozzle location sensing part 38 applies sensing  
signal according to the location of the nozzle 26 to the  
control part 36, and the control part 36 is designed to  
increase the rotation speed of the motor 20 according to  
the location of the nozzle 26, which scans the wafer from  
the edge side to its center. Therefore, the rotation  
10 speed of the wafer 24 chucked on the rotation chuck 22 is  
increased.

15 If photoresist spraying for the wafer 24 moves from  
the edge side of the wafer to its center side in case  
that the wafer 24 rotates in normal speed, the amount of  
photoresist needed for coating is reduced, but the  
coating state on the edge side and the center of the  
wafer is different due to the mechanical relation of the  
elements such as the rotation speed on each point of the  
wafer, centrifugal force, and surface tension. For  
20 example, no-coating in part or mal-coating often occur  
since the photoresist doesn't stick on the center of the  
wafer and falls down along its surface. Also, the coated  
uniformity of the photoresist is reduced.

25 In order to solve the above problem, the motor 20  
applies the rotation force to the rotation chuck 22 by  
varying the force, and the rotation speed of the wafer 24  
is increased considering the mechanical relation of the

elements such as centrifugal force and surface tension,  
according to each section shown in Fig. 3.

That is, since the rotation speed is increased with  
respect to each position considering the centrifugal  
5 force and the surface tension of photoresist when the  
nozzles 26 spray photoresist on the wafer 24 from the  
edge side to its center, it is prevented that photoresist  
is not coated so as to fall down, and mal-functioning of  
the coating is prevented so that the uniformity of the  
10 photoresist is increased throughout the wafer surface  
since the wafer 24 rotates with the maximum speed for the  
coating.

Further, in order to improve the uniformity of the  
wafer center, the time for spraying using nozzle 26 on  
15 the wafer center is increased by 0.2 sec. to get a  
photoresist coating having a uniformity of desired level.

According to another embodiment of the present  
invention, the amount of the photoresist is reduced by  
less than 4 cc, less than the half amount of the  
20 conventional usage of the photoresist.

Therefore, economically the expenses for the  
photoresist is reduced, and the environmental problems  
caused thereby is also reduced.

That is, since the amount of photoresist used during  
25 the coating on the wafer is reduced less than half,  
economically and environmentally the above problems may  
be avoided according to the present invention.

Further, the uniformity of the photoresist coated with on the wafer is also increased.

Still further, while the present invention has been described in detail, it should be understood that various changes, substitutions and alterations can be made hereto without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is :

1. A photoresist coating apparatus for coating the wafer being rotated on a rotation chuck with photoresist sprayed through a nozzle comprising :

5       a nozzle driving means moving said nozzles from the edge side of said wafer to its center for performing scan coating ;

10       a motor for differently supplying rotation force on said rotation chuck with respect to the location of said nozzle ; and

      a control means for gradually building up the rotation speed of said motor by confirming the location of said nozzle which is moved from the edge side of said wafer to its center by said nozzle driving means.

15       2. The photoresist coating apparatus as claimed in claim 1, wherein said control means is constructed such that the rotation speed of said motor is gradually increased non-linearly while said nozzle scan said wafer from its edge side to its center.

20       3. The photoresist coating apparatus as claimed in claim 1, wherein said control means is constructed such that the rotation speed of said motor is gradually increased linearly while said nozzle scan said wafer from its edge side to its center.

4. A photoresist coating method for wafer, wherein photoresist is sprayed while a nozzle scans said wafer from its edge side to its center, the rotation speed of said wafer being increased during said scan.

5            5. A Photoresist coating apparatus and a method thereby, substantially as described herein with reference to and as illustrated in the accompanying drawings.



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Claims searched: 1-5

Examiner: J P Leighton  
Date of search: 7 July 1998

Patents Act 1977  
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B2L(LCDB, LCDA, LCM)

Int Cl (Ed.6): B05B(13/04); G03F(7/16)

Other: Online:WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB2277892A Fujitsu Limited see page 8 line24 to page 9 line 27	1 at least
X	EP0677334A1 Dainippon Screen Mfg. Co. Ltd. see col.3 lines 2-17	.
X	EP0643334A1 AT&T Corpn. see col.3 lines 23-35 & col.4 line 11 <del>et seq</del>	1 and 4 at least
X	EP0454314A2 Machine Technology Inc. see col.5 lines 10-31	.
X	US4267212A Fuji Photo Film Co. Ltd. see col.4 lines 1-57	.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.